

# ENGINE MUFFLER AND METHOD OF MANUFACTURING THE SAME

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to a muffler to be used for the exhaust system of an engine, for example, for automobiles, and a method of manufacturing the same.

### 2. Description of the Related Art

Hitherto, a muffler to be used for the exhaust system of an engine for automobiles or the like such as a sub muffler to be disposed immediately behind the catalytic converter, a main muffler to be placed at the rear of the exhaust system, or a sound absorbing muffler to be disposed in the main muffler, having a sound absorbing material interposed between the internal tube and the external tube is known.

However, in the muffler described above, the sound absorbing material may lean to one side or be deformed after long time of use due to vibration of the vehicle body, vibration of the engine, or expansion and contraction caused by exhaust heat. Especially, when the axial length of the sound absorbing material interposed between the external and the internal tubes is long, it tends to lean to one side, and when different types of sound absorbing materials multilayered in the direction of thickness tend to be subject to slippage or wrinkles at the mating portion. As a consequent, the sound absorbing material

may vary in bulk density and thus lower the sound-muffling capability, or may scatter and thus lowering the durability disadvantageously.

Generally, the muffler as described above is manufactured in such a manner that the sound absorbing material is filled between the internal tube and the external tube, and then the end portion of the external tube is drawn into a tapered shape. In this case, the sound absorbing material is secured by a jig or the like so as not to be displaced in the related art. However, when the diameter of the tapered end decreases, the structure of the jig becomes complex, and there may be cases where it cannot be secured by a jig.

#### SUMMARY OF THE INVENTION

With such circumstanced in view, it is an object of the present invention to provide a durable and easy-to-manufacture engine muffler by securing the sound absorbing material reliably during use or during manufacturing process, and a method of manufacturing the same.

In order to achieve the object described above, an engine muffler and a method of manufacturing the same according to the present invention have the following structure.

The engine muffler of the present invention comprises a sound absorbing material interposed between the external tube and the internal tube, wherein a projection that projects toward

the sound absorbing material is formed on the external tube along almost entire periphery thereof.

A method of manufacturing the engine muffler according to the present invention comprises the steps of interposing a sound absorbing material between the internal tube and the external tube, and drawing the end portion of the outer tube, wherein a projection that projects toward the sound absorbing material is formed on the external tube along almost entire periphery thereof after inserting the sound absorbing material between the external tube and the internal tube, but before drawing the end portion of the external tube.

The advantages offered by the engine muffler and the method of manufacturing the same according to the present invention are mainly that leaning of the sound absorbing material to one end or occurrence of wrinkles thereon due to slippage thereof during manufacturing or usage of the muffler can be prevented only by a very simple structure, or by simply providing a projection projecting toward the sound absorbing material on the external tube. Therefore, this type of muffler can be manufactured easily at low cost, and lowering of sound eliminating capability or durability can preferably be prevented.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partially cross sectional side view showing

an embodiment of the engine muffler according to the present invention;

Fig. 2 is an enlarged view showing the left half portion of the muffler shown in Fig. 1;

Fig. 3A is a cross sectional front view showing a state in which the muffler is suspended from the vehicle body via a stay or the like;

Fig. 3B is a side view of the muffler in Fig. 3A;

Figs. 4A and 4B are explanatory drawings showing an example of the process of manufacturing the muffler; and

Figs. 5A and 5B are explanatory drawings showing another example of the process of manufacturing the muffler.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

An engine muffler and a method of manufacturing the same according to the present invention will be described in detail referring to the embodiment shown in the figures.

In this embodiment, the present invention is applied to the sub-muffler to be disposed immediately behind the catalytic converter that is disposed relatively upstream of the engine exhaust system for automobiles. Referring now to Fig. 1 and Fig. 2, the muffler 1 comprises a sound absorbing material 4 interposed between the internal tube 2 and the external tube 3 and an exhaust air guiding tube 5 provided inside the internal tube 2.

The sound absorbing material 4 is formed of a plurality of kinds of sound absorbing materials 4a-4c having different properties in heat-resistance and sound absorbing capability multilayered in the direction of thickness. In the case shown in the figure, a sound absorbing material 4a formed of a heat-resisting material such as stainless wool is arranged on the outer periphery of the internal tube 1, and a sound absorbing material 4b formed of a heat-resisting material such as glass wool that absorbs the sound better than the sound absorbing material 4a, and a sound absorbing material 4c formed of a sound absorbing material such as glass wool that is less expensive than the sound absorbing material 4b are arranged on the outer periphery thereof. The sound absorbing material 4a also has a function to prevent the sound absorbing materials 4b, 4c from dispersing.

The internal tube 2 and the exhaust air guiding tube 5 are formed respectively with a number of through holes 2a, 5a having different diameters so that the exhaust sound passing through the exhaust air guiding tube 5 is absorbed and eliminated through the through holes 2a, 5a. The both ends 3a, 3b of the external tube 3 are drawn into tapered shapes, and the lengthwise mid section of the external tube 3 is formed with a projection 6 projecting toward the sound absorbing material 4 along almost entire periphery thereof by the use of a pressing roller or the like.

In the figure, the reference numeral 7 designates a short cylinder interposed between the internal tube 2 and the exhaust air guiding tube 5 at both ends for maintaining a space therebetween, and a spacer 8 formed of metal mesh or the like is interposed between the short cylinder 7 and the exhaust air guiding tube 5.

When mounting the muffler 1 constructed as described above in the exhaust system of an engine for automobiles, the exhaust pipe P1, P2 are connected to both ends of the muffler 1. Therefore, the sound absorbing material 4 placed between the internal tube 2 and the external tube 3 is held by the projection 6, and thus is prevented from leaning to one side or being deformed even when vibrations from the engine or of the vehicle body act on the muffler 1. Even when the axial length of the sound absorbing material interposed between the internal tube and the external tube is long, leaning to one side can be prevented. In addition, in the structure in which sound absorbing materials of different kinds are multilayered in the direction of thickness as shown in the figure, occurrence of slippage or wrinkles at the mating portion is reliably prevented.

When the projection 6 projecting toward the sound absorbing material 4 or inwardly is formed on the external tube 3 by the use of a pressing roller or the like, the outer surface of the projection 6 is naturally formed with a recess 6a, which helps to mount a stay or the like for mounting the muffler 1

to the vehicle body easily and reliably. Fig. 3 shows an example, in which a stay 9 of arcuate shape in front view is mounted in the recess 6a formed on the external tube 3 by welding W, and both ends of the stay 9 is suspended from the hanger 11 provided on the bottom portion of the vehicle body via a damping material 10 such as a rubber dumper.

When welding the stay 9, it can easily be positioned by the use of the recess 6a. In addition, by fitting the stay 9 into the recess 6a, it can be welded over a wide area of the stay 9 kept in contact with the external tube 3, and the stay 9 is provided integrally in the recess 6a along the projection 6. Therefore, the stay 9 can easily and rigidly mounted to the muffler 1.

When manufacturing the muffler as is described above, the sound absorbing material 4 is filled between the internal tube 2 and the external tube 3 before drawing at least one end or both ends of the external tube 3 into a tapered shape. In this case, the projection 6 described above is preferably formed after the sound absorbing material 4 is filled but before the end portion of the external tube is subjected to the drawing process.

Examples are shown in Figs. 4A, 4B and Figs. 5A, 5B. Figs. 4A, 4B show the case where a sound absorbing material 4, the internal tube 2, and an exhaust air guiding tube 5 are inserted into the external tube 3 formed generally into a straight tube

as shown in Fig. 4A, and then the projection 6 is formed on the external tube 3 by the use of a pressing roller or the like, and subsequently, the both ends 3a, 3b of the external tube 3 are drawn into the tapered shape by spinning process or the like. Figs. 5A and 5B show the case where a sound absorbing material 4, the internal tube 2, and the exhaust air guiding tube 5 are inserted into the external tube 3 one end 3b of which is drawn into a tapered shape in advance as shown in Fig. 5A, and then the projection 6 is formed on the external tube 3 as described above, and subsequently, the other end 3a of the external tube 3 is drawn into a tapered shape.

It is also possible to assemble the exhaust air guiding tube 5 after inserting the sound absorbing material 4 into the external tube 3 and drawing the both ends of the external tube, without assembling it in advance as described above. The projection 6 may also be formed by the use of the machine for drawing the both ends of the external tube. For example, in the case of applying a spinning process as described above, it can be formed by means of a pressing roller to be used in the spinning process. In this case as well, formation of the projection 6 is preferably be carried out after inserting the sound absorbing material 4 between the internal tube and the external tube 2, 3 but before drawing process is made or finished.

By forming the projection 6 projecting toward the sound absorbing material 4 on the external tube 3 after inserting

the sound absorbing material 4 between the internal tube 2 and the external tube 3 but before drawing the end portion of the external tube, that is, before carrying out the drawing process, or in some cases, simultaneously therewith, the engine muffler can be preferably manufactured without occurrence of slippage or wrinkles at the mating portion of the sound absorbing materials even without a complex jig for securing the internal tube 2 or the sound absorbing material 4 as in the case of the related art.

While the projection 6 is formed continuously along the whole periphery of the external tube 3 into a arcuate shape in cross section in the embodiment described thus far, the cross sectional configuration is arbitrary. It is also possible to form a number of raised or dotted projections along the periphery thereof. While the projection 6 is formed at one position along the length of the external tube 3 in the example shown in the figure, it is also possible to provide the same at a plurality of positions. While a muffler including an exhaust air guiding tube 5 within the internal tube 2 is shown in the figure as an example, it can also be applied to the muffler without such an exhaust air guiding tube 5.